

Customer No.: 31561  
Application No.: 10/604,795  
Docket No.: 9722-US-PA

## AMENDMENTS

### In The Specification

The paragraph sequence stated by the Office Action is shifted by one, according to the E-filing Specification.

Please amend paragraph [0021] and [0022] as follows:

[0021.1] As shown in Fig. 2A, the under-ball-metallurgy layer 220 further includes an adhesion layer 222, a nickel-vanadium layer 224, a wettable layer 226 and a barrier layer 228. The adhesion layer 222 provides a good bondability between the under-ball-metallurgy layer 220 and the bonding pad 216. In general, the adhesion layer 222 is fabricated using a material such as titanium, tungsten, titanium-tungsten alloy or chromium. However, the adhesion layer 222 may also be a composite layer fabricated using some of the aforementioned materials as well. The adhesion layer 222 is formed, for example, by sputtering over the bonding pad 216 of the chip 210 to a thickness between about 0.1 to 1 $\mu$ m. The nickel-vanadium layer 224 is formed, for example, by sputtering over the adhesion layer 222 to a thickness between about 0.1 to 1 $\mu$ m. The wettable layer 226 is formed over the nickel-vanadium layer 224 in an electroplating/electroless plating or a sputtering and electroplating/electroless plating operation. The wettable layer 226 is able to wet the bump material so that bonding strength between the two is improved. The wettable layer 226 having a thickness between about 0.3 to 1 $\mu$ m is fabricated using a material such as copper, nickel, iron, cobalt or metallic alloy~~[an alloy of the metals]~~.

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[0022.1] As shown in Fig. 2A, the barrier layer 228 is formed over the wettable layer 226. Since the barrier layer 228 mainly serves to prevent nickel atoms within the nickel-vanadium layer 224 from diffusing into the solder bump 230, the barrier layer 228 must have properties for blocking nickel penetration. The barrier layer 228 is fabricated using a material such as nickel, iron, cobalt or metallic alloy~~[an alloy of the metals]~~. The barrier layer 228 can also be a composite layer that includes a stack of metallic layers fabricated using the metals or metallic alloy~~[an alloy of the metals]~~. The barrier layer 228 having a thickness between about 0.3 to 1  $\mu\text{m}$  is formed over the wettable layer 226, for example, by electroplating. Tin within the solder bump 230 may react with the barrier layer 228 to form an inter-metallic compound that reduces the growing rate of inter-metallic compound  $\text{Ni}_3\text{Sn}_4$ , resulting from a reaction between the tin within the solder bump 230 and the nickel within the nickel-vanadium layer 224.